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NASA Glenn Research Center Experience Using DOE Midwest Region Super ESPC

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March 2000

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Introduction

On January 23, 1941, during George W. Lewis' tenure as administrator of the National Advisory Committee for Aeronautics (NACA), ground was broken for a facility to study piston engines. The facility was completed on May 20, 1943, and provided mainly research on aircraft engines and propulsion systems until about 1957. The facility was named the Lewis Flight Propulsion Laboratory when Lewis died in 1948.

With the advent of Space Propulsion, the Lewis Flight Propulsion Laboratory acquired property near Sandusky, Ohio to build a nuclear reactor facility to research aircraft nuclear propulsion. Several testing facilities were built on a 6500-acre parcel (2630 ha) purchased in 1960 that became known as the Plum Brook Station. In March 1958, President Eisenhower announced the organization of a space agency to be called the National Aeronautics and Space Administration (NASA), replacing the NACA. The Center became part of NASA and was renamed Lewis Research Center (LeRC). From 1958 through 1966, LeRC continued as an Aeronautical, Space Propulsion, and Power Research and Development Center, providing support to the Mercury and Atlas/Centaur projects.

Throughout the 1970's and 80's, Lewis became known as a center for research, technology, and systems development in aeronautical propulsion, space propulsion, space power, microgravity science, space communication, energy, and related disciplines. During the 1970's, Lewis turned its focus to Earth-based technology. Lewis scientists worked with the Environmental Protection Agency (EPA) in pollution studies of Lake Erie, including the investigative processes for producing cleaner burning coal. Emphasis on computer analysis became very important for the Center. The 1980's brought new programs such as power systems for the Space Station, the Advanced Turboprop project, and the Advanced Communications Technology Satellite (ACTS).

Since 1990, Lewis has continued to provide research support for aeronautical propulsion, space propulsion, and microgravity systems. However, with the constant budget reductions by the U.S. Congress, many Lewis programs have begun to be curtailed, especially in the aeronautics field.

In order to recognize the contributions of both Mr. George Lewis, former director of Aeronautical Research for NACA, and Senator and Astronaut John Glenn, the Lewis Research Center was renamed the John H. Glenn Research Center at Lewis Field on March 1, 1999. Glenn Research Center (GRC) is located on 350 acres (141.6 ha) next to Cleveland Hopkins International Airport. The Center has 177 buildings housing four major research facilities. The original investment cost was about $483 million with an estimated replacement cost in 1999 of ~$1.5 billion.

Glenn's Electrical System

Glenn's electrical system is comparable to that of a large industrial facility and is served by First Energy (The Cleveland Illuminating Company) via four 138-kV overhead transmission lines with a capacity of 494 MW. The 138-kV facility has a capacity of 390 MW, and the 34.5-kV system has a capacity of 310 MW. The average load usage is ~200 MW, and the peak load can reach 325 MW. Glenn has a firm demand contract with First Energy for 21 MW. The actual energy cost can vary between $12 and $14 million. The present estimate for Glenn's fiscal year 1998-1999 is $13.6 million for a usage of 251,227 MWh.

The 34.5 kV system is distributed underground to 11 substations, where the voltage is transformed to 13,800, 6,900, 4,160, 2,400, 790, 480, 240, 480Y/277 and 208Y/120 V. A new 138-kV substation is being built at a cost of over $20 million to upgrade the system to current standards and to provide better system reliability and coordination.

Energy Savings Mandates

The energy crisis of 1973 prompted the Federal Government and private industry to look into alternative methods to save energy. Shared Energy Savings (SES) Contracts were the primary funding vehicles in 1985 for implementing energy conservation programs at Federal agencies. The National Energy Conservation Policy Act (NECPA) became the primary legislation mandating all Federal agencies to improve energy management at their facilities and operations.

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The Federal Government ordered manufacturers to start building energy-saving ballasts (replacing electromagnetic ballasts) for U.S. consumption on January 1, 1990. The new mandate required manufacturers to sell only energy-saving ballasts starting from April 1, 1990. By April 1, 1991, luminaire manufacturers were required to use only energy-saving ballasts in their fixtures.

In 1991, President Bush signed Executive Order 12759 requiring Federal agencies to reduce energy consumption by 10 percent by 1995. In addition, the Energy Policy Act (EPACT) of 1992 mandated that all Federal agencies achieve an energy reduction relative to the 1985 baseline of 20 percent by the year 2000 and 30 percent by 2005. EPACT required implementation of all energy and water conservation projects with a payback of 10 years or less. President Clinton issued Executive Order 12902 in March 1994, reinforcing EPACT's 20 percent energy reduction goal for 2000 and ordering an additional reduction of 30 percent by 2005. The order also required Federal agencies to reduce water usage and encouraged the use of Energy Savings Performance Contracts (ESPC).

Implementation of Energy Savings Programs at Glenn

Constant reductions in operations and maintenance funds during the previous 5 years forced Glenn to look for alternative funding sources in implementing the different Federal mandates on energy consumption. In 1991, members of Glenn's Facilities Operation Division initiated a strategic plan to reduce energy usage significantly. In order to start complying with Executive Order 12759, Library Services (building 60) was selected to be a prototype for a benchmark pilot program. This building was primarily office space, with more stable energy usage than a research facility. Two microprocessor-metering devices were installed to replace standard watt-hour meters to measure energy consumption before and after energy savings implementations. The building heating and ventilating fan coil units were separated on a floor-by-floor basis rather than placed together at one central location, and their controls were placed under the Energy Control Management System (ECMS).

All electromagnetic ballasts of each lighting fixture were replaced with energy-efficient electronic ballasts, and all fluorescent lamps were replaced by more energy-efficient lamps. The modifications were completed in January 1992, and energy consumption was monitored for 12 months. An investment of $22,587 resulted in $6,584 in annual energy savings and a reduction in energy usage of 20.8 percent for a payback of 3.43 years.

A preliminary audit was made of 36 buildings showing that Glenn could save 1,523,171 kWh (based on 52 5-day weeks of 10-hr days) in annual energy usage with an annual savings of $83,774 (based on an average rate of 5.5 cents/kWh). With this encouragement, Glenn proceeded to install ~220 microprocessor devices in the low-voltage switchgears and switchboards of about 65 buildings at an approximate cost of $500,000.

These devices provide accurate energy consumption information that can be stored to establish baseline data for comparison with future energy consumption. In addition to installing these devices between 1992 and 1996, an active program was established to install electronic ballasts and more efficient lamps.

Evaluating the ESPC

All NASA Centers have taken action to comply with the energy reduction mandates. NASA Headquarters reported that by the end of their fiscal year (September 1998), the overall energy reduction progress in Non-Mission Variables (NMV) reached the 26-percent mark below the 1985 baseline. For NASA Glenn, the Super Energy Savings Performance Contract (ESPC) represented one especially promising alternative.

The ESPC is a Federal-private-sector partnership where the energy service company (ESCO) pays the initial cost of purchasing and installing new energy-efficient equipment. The Government repays the ESCO over the life of the contract (up to 25 years) from the savings derived from the utility bill. When the contract is terminated, the Federal Government retains all of the savings and the equipment.

Under the ESPC program the contractor is responsible for the following:

(1) Audit of the facilities
(2) Project proposal
(3) Design and engineering work
(4) Acquiring and installing equipment
(5) Financing
(6) Operating and maintenance
(7) Training personnel
(8) Energy savings and equipment operation
(9) Ongoing project support

Glenn facilities are divided into mission-variable buildings (research) and non-mission-variable buildings (institutional). The 45 mission-variable buildings cover an area of 1.23 million gross square feet (114,429 m^2) and are exempt from energy reduction mandates. The 130 non-mission-variable buildings are subject to the Federal building energy reduction goals and cover an area of 1.22 million gross square feet (112,923 m^2). By definition they include office and storage buildings, laboratories, and other research and development buildings that are not energy intensive.

Glenn prepared an ESPC package during 1995, and the National Renewable Energy Laboratory (NREL) provided an extensive audit of the institutional buildings selected for this project. Glenn sent out a Request For Proposal (RFP) in March 1996. At least 10 contractors showed interest and participated

in a site showing in April 1996. Owing to a conflict with the RFP requirements that Glenn was preparing for the Fixed Price Contract and with several buildings closing at a later date, the proposal was withdrawn and cancelled.

GRC Selection for DOE Midwest Region Super ESPC

Several members from the Glenn Energy Team attended a workshop on ESPC's at NASA's Wallops Flight Facility, Wallops Island, Virginia in 1996. From the experience gained at this workshop, Glenn prepared a new ESPC package, which was ready to go out again for solicitation in February 1997. When DOE contacted Glenn and invited the Center to participate in the Midwest Super ESPC, they were looking for a valid candidate. NREL recommended Glenn because the ESPC package would meet the DOE requirements.

The DOE Super ESPC management team made a presentation to Glenn in March 1997. In addition to the benefits listed in Section 5, the contracts are for the use of all Federal agencies in this particular region. Once in place, the Super ESPC allows the facility managers of the participant agency and other Federal agencies to negotiate site-specific delivery or task order contracts with five or six selected ESCO's without having to start the contracting process from scratch.

The Super ESPC contains terms and conditions that save procurement lead time and result in energy and money savings. The DOE shows that the Super ESPC is a viable source of facility improvement funding that can create larger project scope by bundling projects. It also allows the replacement of aging, inefficient equipment, facilitates better management of operations and maintenance costs and staff, and improves facility comfort, function, and environment.

With the assurance from the DOE that Glenn was to be one of the two candidates to participate in the Midwest Super ESPC program, the Energy Team went immediately to work to help DOE's Audit Team get the energy data for the selected buildings and develop the data package. The RFP solicitation went out early in July 1997. A site tour of the facilities in July 1997 was attended by 24 ESCO's, 19 of whom submitted proposals. The energy manager was required to attend an extensive training program sponsored by DOE on regional Indefinite Delivery Indefinite Quantity (IDIQ) at Denver, Colorado in June 1997.

The technical evaluation took place in October 1997. Even though the evaluation was to be done by the Glenn Energy Team, DOE decided that the energy manager would do the technical evaluations of the ESCO submittals while the DOE Evaluation Team reviewed the financial submittals of the same companies.

Glenn provided technical evaluations of the 19 proposals to DOE by November 1997. By early January 1998, DOE had pared the submittals down to 12 companies based on the cost submittal and cost range established by the DOE. The next step was to narrow the candidates to six, and then down to three. Glenn became involved in the ranking of the three finalists based on cost, savings, and technical evaluation. The Glenn procurement specialist and contracting officer evaluated the financial end while the energy manager reviewed once more the technical aspects of the submittal.

The six selected ESCO's were Duke Solutions, Inc.; CES Way International; Energy Resources, Inc. (ERI); EUA Cogenex; Johnson Controls, Inc.; and NORESCO. After the review of the qualifications was completed, Glenn selected Duke Solutions. The DOE selected the Super ESPC candidates for the Central Region at the same time as those for the Midwest Region. Because the DOE Selection Committee required additional reviews and documents for the Central Region evaluation, the award announcement for both regions was not made until July 1998.

The DOE Technical Support Team representative helped Glenn to prepare the Delivery Order Request for Proposal (DO RFP) at the end of April 1998. The DO RFP was completed by the end of July 1998 and was received by the selected ESCO (Duke Solutions) in September 1998. The DO RFP provides site specifics and any unique requirements such as the scope of the work, facility energy use data, and performance standards.

Some of the elements of the DO RFP are the Indefinite Delivery Indefinite Quantity (IDIQ) contract terms and conditions, the DO project description, and the selected ESCO proposal. The Glenn project description consisted of boiler improvements in 3 buildings; heating, ventilation, and air conditioning in 4 buildings; lighting improvements in 15 buildings (i.e., electronic ballasts, energy-efficient lamps, and motion sensors); improvements in the Chilled/Hot/Steam Piping and Distribution Systems at the boiler plant; and replacement of motors and drives with more efficient models in 8 buildings.

The selected ESCO came to Glenn on October 6, 1998 to visit the site, make a presentation, and discuss the DO requirements. The ESCO energy engineers conducted extensive audits, surveys, and project assessments with the support of the Glenn Super ESPC team during November 1998. The ESCO visit resulted in a reevaluation of the buildings to be involved in the final proposal.

The ESCO proposed energy conservation measures on lighting systems upgrades, lighting controls, boiler economizer, and lower drum steam-heating coils. (The work will be completed in 8 months and save ~$200,000 and 18,000 million British Thermal Units (BTU), or 19 trillion J/year.) The capital investment is ~$1.2 million for a contract term of 7 years. All cost savings will be retained by the ESCO in order to minimize the contract period.

Glenn has been negotiating the final details with the ESCO since January 1999. Most of the technical details have been resolved. The DOE solicitation allows ~30 percent markup on the actual investment; Glenn is presently negotiating a markup of 15 to 20 percent. Glenn is also completing the Congressional

Notification Letter required by NASA Headquarters to submit to Congress for approval prior to implementing a contract with an ESCO with an energy conservation project capital investment exceeding $750,000. It is expected that the Super ESPC project can start during the summer of 1999. Figure 1 shows the DOE Super ESPC Regions and the location of each NASA facility in its corresponding region.

Conclusion

Glenn's experience shows that for a Regional Super ESPC to succeed, the following elements are necessary: management support and commitment; an innovative, problem-solving team; involvement of all parties in the process, Management, Technical, Contracting, Budget, Finance, and Legal; Energy Saving Performance Contracting (ESPC) knowledge and training; assessment of needs and desired results; planning, issues identification, and resolution; dedication of staff resources and time; a knowledgeable support network.

A successful Super ESPC can yield benefits such as viable facility improvement funding; bundling of projects to increase project scope; replacement of aging, inefficient equipment; manageable operation and maintenance costs, including staffing; and improvement of facility comfort, function, and environment.

Glenn Research Center
National Aeronautics and Space Administration
Cleveland, Ohio, January 24, 2000

Appendix

Preliminary results from implementation of the Super ESPC at NASA Glenn Research Center are now available and will be included here.

Prior to signing a contract with Duke Solutions, Inc., Glenn was required to submit a Congressional Notification Letter to NASA Headquarters, as previously explained. The Congressional Notification Letter was submitted to Congress on May 27, 1999, and Glenn received approval to proceed from NASA Headquarters on July 28, 1999.

Almost a year went by after Duke Solutions received the Glenn Delivery Order for Proposal before a contract was signed. The delay was caused by extensive reviews, meetings, and technical evaluations. Once these were completed, a contract was signed with Duke Solutions on August 5, 1999.

A preconstruction meeting was held with the Glenn Energy Team and the Duke Solutions ESPC team on September 9, 1999. The project was planned to begin October 1, 1999, but the contract was actually implemented on December 13, 1999.

The final scope of the project included the following:

1. Lighting system upgrades for buildings 23, 24, 28, 37, 60, 74, 84/137, 110, 142, 301, 309, 316/320, and 333
2. Lighting controls for the above-listed buildings
3. Economizer installation in boiler 4 in building 12
4. Lower drum steam heating installation in boilers 3, 4, and 5 in building 12

The project will be inplemented during 8 months at a gross project cost of $1,747,830.

The gross guaranteed cost savings are $1,980,919, with a simple payback contract of 7.2 years at an annual rate of $275, 127. At the end of 7.2 years, Glenn will own 100 percent of the updated facilities and all savings thereafter.

The savings were derived as follows:

Electricity

Projected yearly usage based on fiscal year 1999 was 251,228,000 kWh. Projected energy savings will be 1,450,000 kWh/yr for an annual savings of 5.77 percent.

Natural Gas

Projected yearly usage based on fiscal year 1999 was 567,126 MCF (MCF, million cubic feet; 16 061 Mm^3). Projected natural gas savings will be 18,800 MCF (532.4 Mm^3) for an annual savings of 3.2 percent.

The projected combined cost for electrical and natural gas usage in fiscal year 1999 was estimated at $16,110,381. The projected annual cost savings of $275,127 represents a 1.71-percent utility savings.

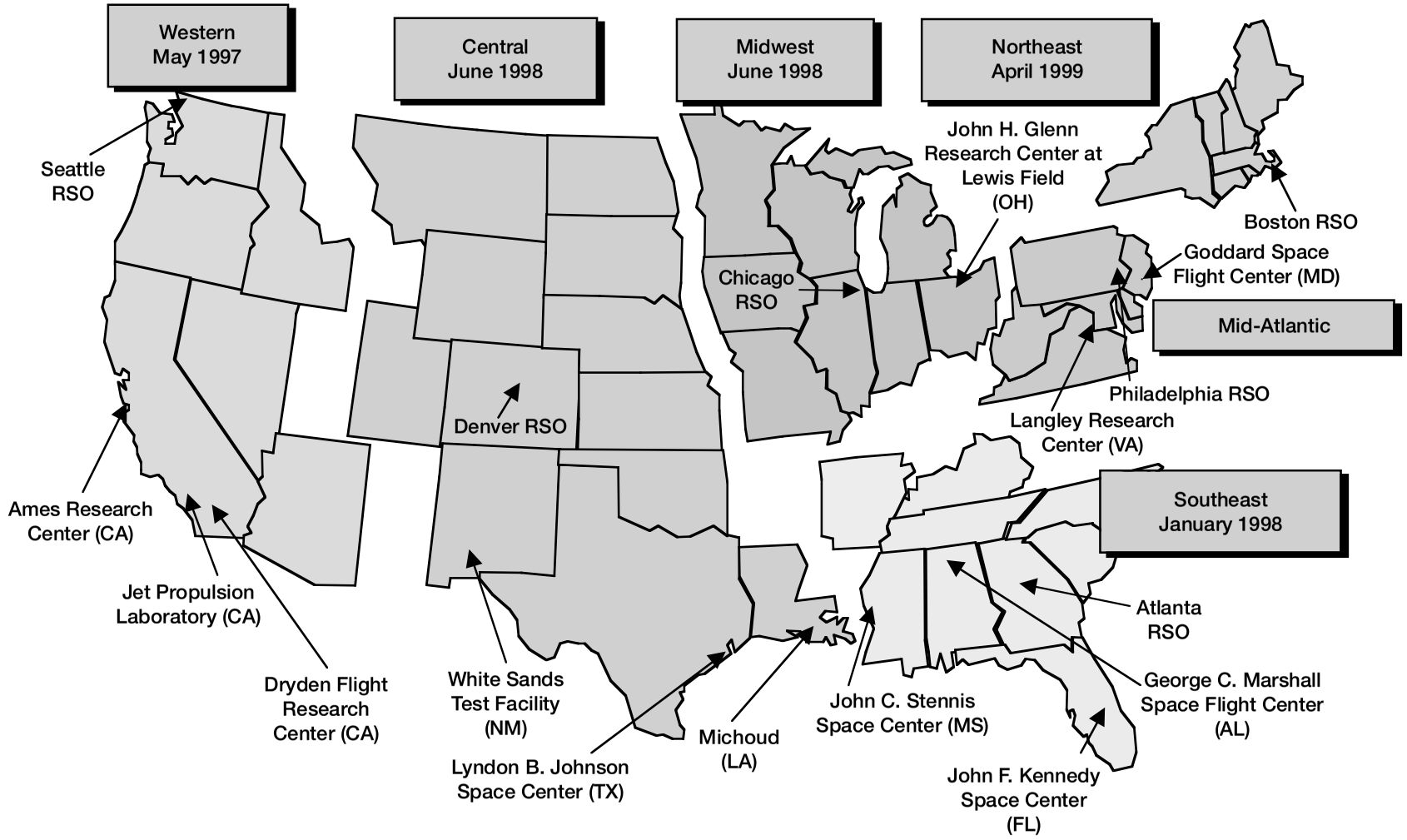

Figure 1.—DOE Super ESPC Regions (with dates when Super ESPC's were awarded; award for Mid-Atlantic Region to be announced), DOE regional support offices, and NASA Centers in corresponding regions.

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The energy crisis of 1973 prompted the Federal Government and private industry to look into alternative methods to save energy. At the same time the constant reduction of operations and maintenance funds during the last 5 years forced Glenn Research Center (GRC) to look for alternative funding sources to meet the mandate to reduce energy consumption. The Super Energy Savings Performance Contract (ESPC) was chosen as a viable source of facility improvement funding that can create larger project scope and help replace aging, inefficient equipment. This paper describes Glenn's participation in the Department of Energy (DOE) Super ESPC program. This program provided Glenn cost savings in the performance of energy audits, preparation of documents, evaluation of proposals, and selection of energy service company (ESCO).

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